



**BOSCH**

**BHI380**

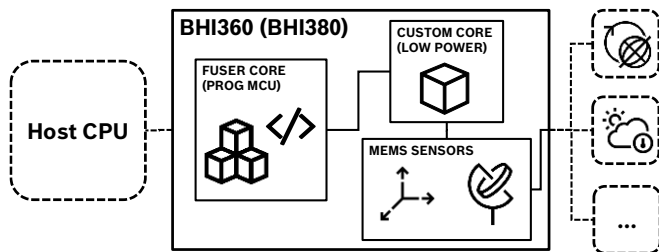
Programmable AI sensor system



## 1 General description

The BHI380 is a highly integrated, ultra-low power, customizable smart sensor system consisting of a best-in-class 6-axis IMU, a programmable 32-bit microcontroller (Fuser2 Core), a second ultra-low power MCU, with a powerful software framework containing pre-installed sensor fusion and other sensor data processing software within a 2.5 mm x 3 mm LGA package, Pin2pin backward compatible with Bosch Sensortec IMUs. The BHI380 is a variant from the BHI3xx family featuring a larger set of integrated application specific algorithms.

The Fuser2 Core in the BHI380 is intended to be used as co-processor, offloading the main CPU from sensor data processing tasks, like sensor fusion, position tracking, activity and gesture detection with high precision and low latency while significantly reducing the overall system power consumption.



## 2 Overview features

### Hardware features

- ARC EM4 CPU (up to 3.6 CoreMark/MHz)
- Floating Point Unit (FPU)
- Memory Protection Unit (MPU)
- 4-channel micro-DMA Controller
- ARCV2 16/32-bit instruction set

### Low Power CPU (Bosch Sensortec Core):

- Optimized for accelerometer based always-on algorithms

### Memory

- 256 kB on-chip SRAM
- 144 kB on-chip ROM preloaded with software

### Connectivity

- Host interface configurable as SPI or I2C
- 2 secondary master interfaces (one I2C interface, and one selectable SPI or I2C)
- Up to 14 GPIOs
- Fast I/O operations:
  - SPI and GPIOs up to 50 MHz
  - I2C up to 3.4 MHz

### Integrated sensor (6-DoF IMU)

- 16-bit 3-axis accelerometer
- 16-bit 3-axis gyroscope

### BHI380 TARGET APPLICATIONS

- Wrist wearables such as smartwatches, fitness bands and smart hybrid watches
- Head mounted devices such as headsets, truly wireless in-ear devices and smart sunglasses
- Other smart battery powered devices
- Especially suited for pedestrian navigation, fitness and exercising applications and swimming analytics

### Software features

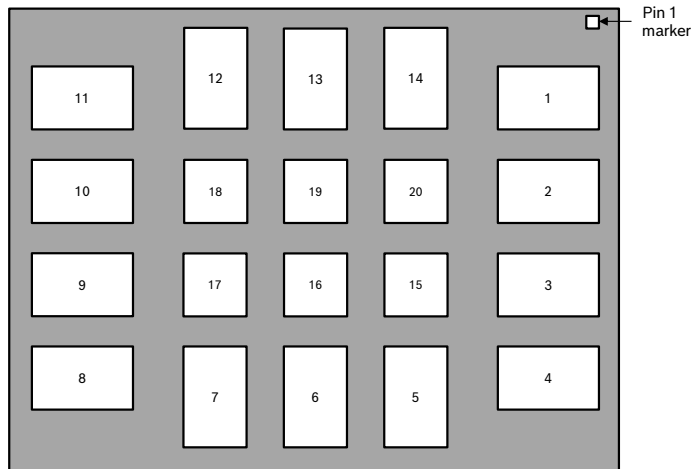
- Open sensor platform for development of custom embedded algorithms for Fuser2 Core (MCU)
- Integrated event-driven software framework and OpenRTOS™ with virtual sensor stack
- Integrated BSX sensor fusion software library including dynamic offset auto-calibration algorithms, 6DoF and 9DoF 3D device orientation, gravity vector, etc.
- Support for high performance mode as well as several low power modes
- Optimized algorithms running on ultra-low power Bosch Sensortec Core including step counter, tap detection, gesture detection and activity recognition
- Powerful SDK for easy customization with support for
  - Metaware C Compiler and GNU C Compiler for ARC
- Self-learning AI software suitable for a wide variety of fitness tracking and custom motion patterns
- Dedicated solution for tracking swimming performance in smart watch
- Dedicated solution for pedestrian dead reckoning (PDR) for indoor and outdoor positioning

### 3 Technical specification

#### BHI380 technical data

Operating voltage	1.8 V
Current consumption	
Fuser2 (running CoreMark)	
▪ Long Run mode (20 MHz)	950 µA
▪ Turbo mode (50 MHz)	2.8 mA
Sensor Fusion (Hub + IMU) operation (calculating Game Rotation Vector)	
▪ 800 Hz ODR	1.2 mA
▪ 100 Hz ODR	1.0 mA
Standby current	8 µA
Sensor Fusion Performance	
▪ Static accuracy (Heading, Pitch, Roll)	2, 2, 2 degrees
▪ Dynamic accuracy (Heading, Pitch, Roll)	7, 2, 2 degrees
▪ Calibration time	<1 second
▪ Orientation stabilization time	0.2 seconds

#### Pin configuration



Pin-out bottom view

Pin	Name	Description
1	HSDO	Host Interface SPI MISO / I2C address select
2	ASDX	OIS MOSI / Aux I2C SDA M2: SPI MOSI / I2C SDA
3	ASCX	OIS Clock / Aux I2C SCL M2: SPI SCK / I2C SCL
4	HIRQ	Host Interrupt Output
5	VDDIO	Digital IO and Fuser Supply
6	GNDIO	Digital IO and Fuser Ground
7	GND	Analog Sensor Ground
8	VDD	Analog Sensor Supply
9	VREG	Voltage regulator output
10	OCSB	OIS Chip Select Input M2: SPI Chip Select 1
11	OSDO	OIS MISO M2: SPI MISO / I2C unused
12	HCSB	Host Interface SPI CSN / Protocol Select
13	HSCX	Host Interface SPI SCK, I2C SCL
14	HSDX	Host Interface SPI MOSI, I2C SDA
15	JTAG_CLK/M3SCL	Fuser Debug Clock / M3 I2C SCL
16	JTAG_DIO	Fuser Debug Data
17	RESETN	Reset input, active low
18	M3SDA	M3 I2C SDA
19	RESV2	Reserved: do not connect
20	RESV1	Reserved: do not connect

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